# PROGRAM REVIEW
# 1981 - 1982

## NEWFOUNDLAND FOREST RESEARCH CENTRE

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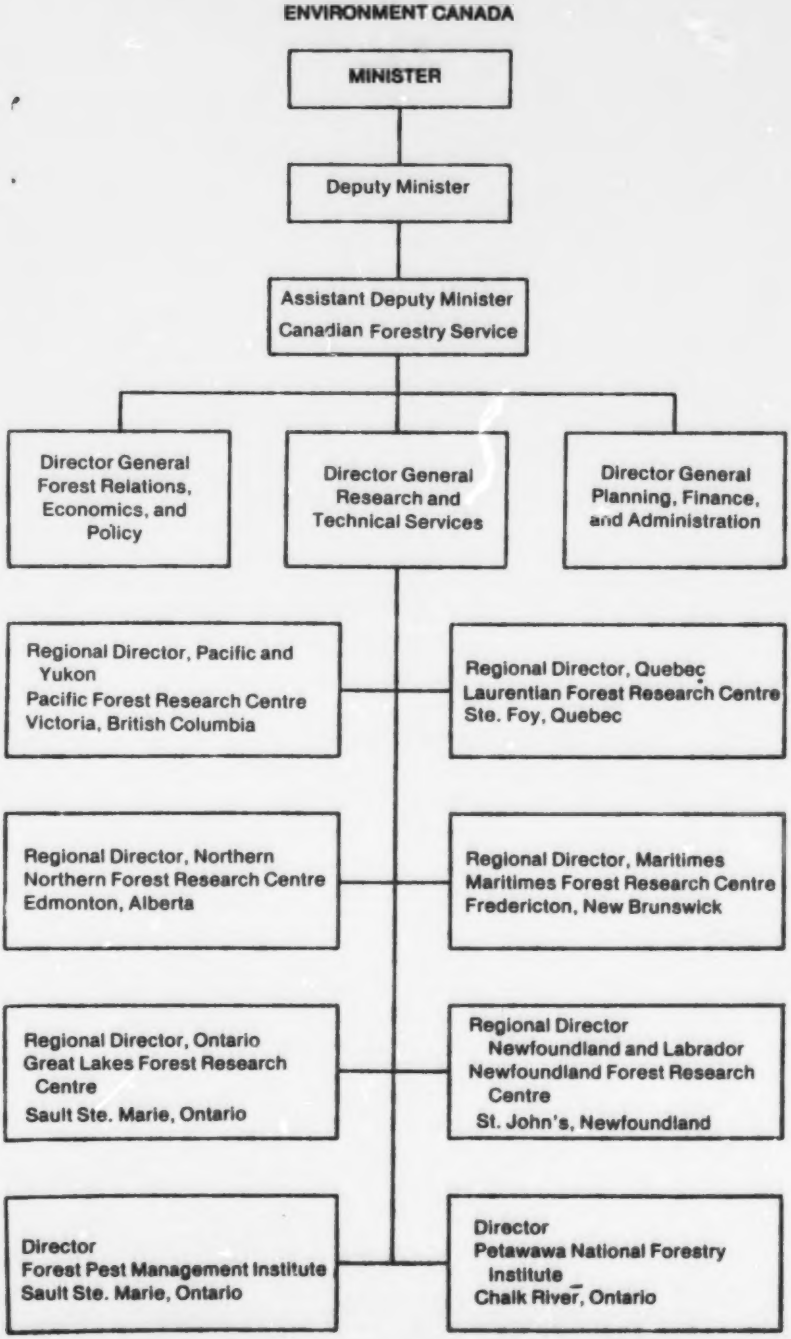
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Program Review
1981-82

# NEWFOUNDLAND FOREST RESEARCH CENTRE

CANADIAN FORESTRY SERVICE

ENVIRONMENT CANADA

1982

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## THE CANADIAN FORESTRY SERVICE
## ENVIRONMENT CANADA

The Canadian Forestry Service is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social and environmental benefit of Canadians.

The following are the main functions for the CFS:

1. Coordination of federal policies, in the promotion of better resource management and forest industry development.

2. Provision of scientific and technological leadership in forestry through research and development.

3. Provision and analysis of national and international statistics and information as a basis for policy formulation.

4. Development and certification of codes and standards for wood product performance.

5. Protection of Canada's forests from foreign pests.

6. Fostering the potential use of the forest resource for energy.

7. Contributing to the environmental objectives of the Department of the Environment.

The Canadian Forestry Service is comprised of a Headquarters Unit, six Forest Research Centres and two National Institutes. The Forest Research Centres are concerned primarily with regional problems while the institutes undertake programs of national concern.

**The Research Centres are:**
Newfoundland Forest Research Centre, St. John's, Newfoundland
Maritimes Forest Research Centre, Fredericton, New Brunswick
Laurentian Forest Research Centre, Ste. Foy, Quebec
Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario
Northern Forest Research Centre, Edmonton, Alberta
Pacific Forest Research Centre, Victoria, British Columbia

**The two National Institutes are:**
Petawawa National Forestry Institute, Chalk River, Ontario
Pest Management Institute, Sault Ste. Marie, Ontario

## LE SERVICE CANADIEN DES FORETS
## ENVIRONNEMENT CANADA

Le Service canadien des forêts est le principal organisme compétent en matière de foresterie au gouvernement fédéral. Son objectif général est de promouvoir l'utilisation avisée des ressources forestières canadiennes dans l'intérêt économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. Coordonner les politiques fédérales en vue d'améliorer la gestion des ressources et le développement de l'industrie forestière.
2. Fournir, par la recherche et le développement, un leadership scientifique et technique en matière de foresterie.
3. Fournir et analyser des statistiques et des informations nationales et internationales pouvant servir à l'élaboration de politiques.
4. Établir et certifier des codes et des normes relatifs aux produits forestiers.
5. Protéger les forêts canadiennes contre les déprédateurs provenant de pays étrangers.
6. Favoriser l'utilisation du potentiel des forêts comme source d'énergie.
7. Contribuer aux objectifs de protection de l'environnement du ministère.

Le Service canadien des forêts est constitué d'une administration centrale, de six centres de recherches forestières et de deux instituts nationaux. Les centres de recherches s'occupent principalement des problèmes régionaux tandis que les instituts entreprennent des programmes d'intérêt national.

**Centres de recherches:**

Centre de recherches forestières de Terre-Neuve, Saint-Jean (Terre-Neuve)
Centre de recherches forestières de Maritimes, Fredericton (Nouveau-Brunswick)
Centre de recherches forestières des Laurentides, Sainte-Foy (Québec)
Centre de recherches forestières des Grands lacs, Sault-Sainte-Marie (Ontario)
Centre de recherches forestières du Nord, Edmonton (Alberta)
Centre de recherches forestières du Pacifique, Victoria (Colombie-Britannique)

**Instituts nationaux**

Institut forestier national de Petawawa, Chalk River (Ontario)
Institut pour la répression des ravageurs forestiers, Sault-Sainte-Marie (Ontario)

Le rapport ci-joint décrit le programme du Centre de recherches forestières de Terre-Neuve pour la période d'avril 1979 à mars 1981. Il présente les principaux projets de recherche, décrit brièvement les réalisations du centre et énumère les principales publications et les documents préparés par le personnel de recherche. Le centre réalise environ 60 études réparties entre 15 projets. Le programme de recherche global est divisé selon les activités suivantes:

Recherches sur les ressources forestières et l'environnement
Recherches sur la protection des forêts
Economie forestière
Services d'information
Administration

En avril 1981, le centre comptait 66 employés: 26 professionnels, 27 techniciens et 13 personnes dans le secteur de l'administration et du soutien.

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# Introduction

This report describes the program of the Newfoundland Forest Research Centre (NeFRC) for the period April 1981 to March 1982. It identifies the principal research projects, lists the various studies, summarizes the achievements, and lists the publications and related productivity of the research staff. This is the first annual review produced by NeFRC; biennial reviews have been produced since 1966.

The Research Centre conducts most of the forestry research in the Province of Newfoundland and Labrador. Its objective is to provide the scientific, technological and economic information services required for the improvement, protection, and efficient utilization of the forest resource of the Province. Its principal clients are the Provincial Department of Forest Resources and Lands, the Newfoundland forest industries, federal agencies having forestry and related programs, and the public who frequently seek advice on forestry problems. The research undertaken includes about 80 studies organized under 18 projects. During the year seven research projects were given formal evaluation by special evaluating committees selected from several agencies which have forestry and related interests, e.g. university, provincial forest and environmental agencies and other federal agencies.

In April 1982 the staffing complement of NeFRC was 68 person years comprised of 28 professional staff, 28 technical staff, and 12 administrative and related support staff. Additionally, there were 26 students on staff for the summer who were part of a career-oriented student employment program. Two research officers were granted educational leave of absence tc improve their research qualifications. Staffing of five vacant positions was achieved including one biological control scientist for special francophone assignments. Construction of a greenhouse complex was undertaken to provide improved facilities for certain established projects and to accommodate new LRTAP studies. A number of other activities which are closely associated with NeFRC Management are described under Administration, Information Services, and other activities.

The principal research and development activities of the Research Centre are organized under the following five broad programs:

## Forest Resources and Environmental Research

Forest resources research involves the acquisition of biological data on forest and wildland ecosystems and the development of concepts in intensive forest management to ensure a continuing supply of industrial wood and to preserve aesthetic and associated forest values. Activities are varied and include studies of soils, fertilizers, reforestation, tree growth and forest genetics.

Studies of the distribution and stocking of softwood regeneration on black spruce cutovers continued. Information from these studies has had a direct impact on standard regeneration survey procedures and stocking standards for Newfoundland. A series of planting stock comparison trials on recently burned sites, and spacing and fertilization trials were

established in cooperation with the Department of Forest Resources and Lands and the forest industry. A study to investigate microclimate conditions associated with urban space and shelter was initiated.

Ecological investigations of lands having special ecological characteristics and utilization capabilities (e.g. peatlands and heathlands) and of selected native tree species were expanded. NeFRC has had a major input into organization of the newly-formed Peat Forum which has developed a national R and D program on peatland inventory methodology.

The productive potential of various native and exotic tree species suitable for reforestation in Newfoundland was evaluated through species and provenance testing, breeding and selection. Major efforts are being made to ensure that research findings are translated into economic and environmental gains.

Research continued under the ENFOR program to determine the potential of using forest biomass as an energy source. A major contract was let to Bowater Newfoundland Limited to assess the potential of industrial-scale harvesting of forest biomass as an alternate fuel.

Enviromental studies concentrated on determining the impact of industrial practices on the forest land and on developing practical guidelines for minimizing and ameliorating disturbances. Research on industrial atmospheric pollution was conducted under the LRTAP and Toxic Chemicals programs. Important results included informaton on the buffering capacity of foliage of selected tree species and on the effects of acid rain on pollen and seed germination. A method of sulphur analysis using ion chromatography was developed and refined.

## Forest Protection Research

Research and services programs in forest protection include surveys for the detection of forest insects and diseases, the monitoring and forecasting of their geographic distribution and intensity, and an assessment of damage. Research is conducted on the biology of important pest species, on natural control factors and on the development of pest management strategies and guidelines to minimize forest losses to insects and diseases.

Surveys continued to concentrate major efforts on the spruce budworm outbreak. Important developments included the initiation of a two-year period of technology transfer of damage assessment methods to the Inventory Division of the Department of Forest Resources and Lands to aid in their preparation of operational scale damage maps. Information generated by surveys is also being used in a contract research project to develop methods for the use of Landsat data to detect and document forest change including harvesting, regeneration and damage by pests and fire. A survey in cooperation with all agencies was intiated in 1982 to define the distribution of the recently discovered Scleroderris canker throughout Newfoundland.

There was increased emphasis on research into biological control factors of native and introduced pests. A major contract was awarded to the Biology Department of Memorial University to determine the feasibility of using nematodes for spruce budworm control. Research staff also serve as scientific authority on contracts awarded by the Department of Forest Resources and Lands for biological control of pests.

The Forest Fire Research component of the program was temporarily discontinued this year although strong need was expressed for work in this field by the forestry agencies. The lack of a supporting technical person

year for the vacant research position made it unrealistic to continue forest fire research.

The Forest Protection Research program was formally evaluated in February 1982 and subsequently the staff held a two-day seminar in Grand Falls and Corner Brook. The seminar was well attended by representatives of industrial and government forest agencies and received good coverage by radio, television and the press.

### Forest Economics

A forest economics section assesses the contribution of the forest industry to the provincial economy and undertakes economic analyses of various forestry activities. A forest economics advisory service is provided to federal and provincial government agencies and to the forest industry. The section also participates in the development of federal/provincial forestry agreements and is responsible for the Newfoundland region input into the Canadian Forest Resource Data program.

### Information Services

The aim of the Centre's public information program is to promote the research activities of the Canadian Forestry Service and to generate public awareness and appreciation for the forest resource in Newfoundland. This aim is accomplished by the production of brochures and leaflets on various aspects of forestry and related subjects, conducting seminars, visiting schools, organizing media interviews, preparing audio-visual presentations, conducting displays to illustrate forestry research activities and the publication of a bi-monthly newsletter.

A priority of the program is support to schools both secondary and post-secondary and to civic youth organizations. Direct liaison is maintained with these organizations and consequently material is produced with these groups as the target audience. The information program began in 1967 and it is still developing with the intent to fully satisfy forestry information requirements to all segments of the public.

### Finance and Administration

This section provides financial and material management, office services, records, personnel and library services, in addition to the operation of two field stations.

W. J. Carroll
Regional Director
Canadian Forestry Service
Newfoundland

# Forest Resources & Environmental Research

## PROJECT 221
## Reforestation

**Objectives:** To develop and demonstrate silvicultural techniques required to overcome site problems adversely affecting forest productivity in Newfoundland; to determine regeneration stocking levels required to ensure a productive forest stand at maturity; to determine the maximum gains possible in forest productivity through reforestation and other intensive silvicultural treatments.

**Achievements:** Detailed studies of distribution and stocking of softwood regeneration on black spruce cutovers were continued. Progress was made in establishing relationships between regeneration stocking and plot size, and between stocking and seedling density. A new plot size was recommended for sequential regeneration surveys on black spruce cutovers. A preliminary set of stocking standards has been determined for black spruce cutovers. These results are having a direct impact on the development of standard regeneration survey procedures and stocking standards for Newfoundland. Surveys were conducted in western Newfoundland to determine the nature and extent of the hardwood competition problem. A publication was prepared on the result of a recent remeasurement of an experiment which compared various techniques for releasing softwood regeneration from unmerchantable hardwoods. The experiment included techniques of brushcutting and treatment with three different herbicides. Development and improvement of the regeneration research demonstration area at North Pond has continued, and the first draft of a publication on the North Pond experimental program was prepared. Survival and growth in existing peatland plantations in central Newfoundland were remeasured. However, further experimentation in peatland afforestation in Newfoundland has been halted until proper ditching equipment can be obtained. Advice was given to provincial authoritires on the development of a peatland draining and afforestation program in western Newfoundland. In cooperation with the Province and industry, a series of planting stock comparison trials on recentiy burned sites was established. Treatments being compared include different age classes of bareroot stock, several types of containerized seedlings and shelter seeding techniques. Information on these trials was presented to an international audience in a poster session at the Canadian Containerized Tree Seedling Symposium in Toronto. A second series of trials has been planned also to compare planting stock of different grades or sizes. The role of shelterbelts in relation to energy conservation is being studied. Fifteen tree species were planted in two urban shelterbelts in St.

John's. The growth of **Larix** species in an established heathland shelterbelt was measured and several **Salix** species were collected for use in a heathland shelterbelt study. A summary of CFS research on black spruce in Newfoundland was published as an information report. A report on "Regeneration and Reforestation" was prepared at the request of the Royal Commission on Forest Protection and Management by a small inter-agency committee of technical experts chaired by an NeFRC staff member. A paper on "Silvicultural research priorities for Newfoundland" was also developed with input from Provincial and industry forestry staff. One information report was prepared on the control of hardwoods vegetation, and another on the growth of natural tree seedlings on a fen after drainage and fertilization.

### List of Studies

1. Techniques to control alder competition in artificially seeded stands.
2. Control of hardwoods on highly productive forest sites.
3. Control of Kalmia invasion on productive forest sites.
4. Afforestation of peatlands and heathlands.
5. Regeneration research at North Pond experimental area.
6. Shelterbelt research on heathland, peatland, and urban environments.
7. Development of regeneration stocking standards for Newfoundland and Labrador.
8. Silvicultural workshops and regeneration prescription demonstrations.
9. Plantation Research.

## PROJECT 231
## Forest Genetics

**Objectives:** To identify provenances of native and exotic species suitable for various sites in Newfoundland; to determine the amount of genetic gain possible in such native species as black spruce, white spruce and larch; to develop interspecific hybrids of **Larix** for testing under Newfoundland growing conditions; and to determine the suitability of selected poplar species and hybrids for afforestation and reforestation in Newfoundland.

**Achievements:** Black spruce provenances suitable for various sites were identified and the sites ranked for their suitability. Provenances 35-40% better than the average were also identified. Open-pollinated individual tree seed from 22 locations across the Island and control pollinated seed from one location were collected. Isozyme studies initiated on this material in 1980 were completed and two publications are being prepared. Studies on the physical and anatomical properties of the wood from these samples were completed and those on chemical properties are in progress. Also data on the characters of cone morphology and seed weight of the collected material were analyzed and heritability of the characters calculated. A series of controlled crosses was done and seed yields from self and cross-fertilization were compared. The seedlings are now being grown in the nursery. Studies on white spruce showed that plus trees can be selected on the basis of seed weight but not on characters of cone

morphology. Biochemical studies on the foliage of "plus", "ordinary", and "minus" trees were completed. Controlled pollination was done on superior provenances and seed from intra- and inter-provenance crosses obtained. The seedlings are being evaluated in the greenhouse. Larch has a growth rate faster than other indigenous species in Newfoundland and is adaptable to a wide range of conditions. Studies have centred on obtaining superior trees for seed production. Studies on microsporogenesis of **L. laricina** were completed. Studies on pollen formation of **L. kaempferi, L. decidua** and **L. eurolepis** were continued. NeFRC will participate in an all-range provenance trial of larch coordinated by the Petawawa National Forestry Institute. Work on exotic tree species included measurements of survival and growth of a number of experiments initiated earlier. A second measurement of a Sitka spruce provenance experiment was made. Four field experiments on hybrid and exotic poplars were measured and the data anlayzed. Survival and growth studies based on 15-year results were published for **Larix** and for native **Picea** species.

Miscellaneous achievements included the production of two information reports, two journal publications and three file reports. Two reports were prepared for the Royal Commission on Forest Protection and Management; one, on seed procurement and nursery production by a small task force chaired by an NeFRC researcher; the other on forest genetics by the project leader. Two monographs were prepared and are currently under review — one on the genetics of black spruce, a cooperative undertaking with the Society of American Foresters and the other on the potential of conifers for biomass production for energy in cooperation with the International Energy Agency.

### List of Studies

1. Genetic improvement of black spruce in Newfoundland.
2. Genetic improvement of white spruce in Newfoundland.
3. Genetic improvement of larch in Newfoundland.
4. Growth patterns of balsam fir from different origins.
5. Provenance experiments of exotic fir and spruce species.
6. Trials of hybrid and exotic poplars.
7. trials of exotic softwood species.
8. Advisory services to the Tree Improvement Working Group.

## PROJECT 241
## Tree Growth Research

**Objectives:** To assess the growth and yield potential of Newfoundland's principal tree species in response to practices of stand manipulation.

**Achievements:** Fourteen forest fertilization trials comprising 250 permanent sample plots have been established in Newfoundland. Approximately 700 black spruce trees and 30 white birch from these plots were cut and about 6000 discs prepared for detailed growth measurements. However only about 500 of the discs have yet been measured due to technical problems with the measuring equipment. A new piece of equipment has since been

obtained and the measurements are proceeding. Two pre-commercial thinning trials, one in young black spruce and one in young balsam fir were established. These will test four levels of thinning and one level of nitrogen fertilization at one spacing. The objective of these trials is to determine growth rates of young forest stands on a variety of sites across the Island. In the study to determine relationships between tree growth and respiration in young balsam fir trees under thinned and unthinned conditions, a field laboratory was established in a forest area of western Newfoundland. Respiration rates for fifteen balsam fir trees, covering a range of diameters and crown classes in thinned and unthinned stands, were determined at various periods during the day and night over a three-month period. When completed, this study should determine levels of growth efficiency in stands of various densities. A xylometer for accurate measurement of tree volume by immersion was developed and tested. Additional tree samples were collected for growth measurements and analyses. A special report on Forest Stand Tending undertaken jointly by NeFRC and Bowater Newfoundland Limited was submitted to the Royal Commission on Forest Protection and Management.

### List of Studies

1. Influence of stand density on productivity of natural and planted stands.
2. Forest fertilization trials.
3. Forest productivity on cutovers.
4. Relationship between growth and respiration in young balsam fir trees.

## PROJECT 341

## Energy from Forest Biomass

**Objectives:** To determine the feasibility and develop strategies for the utilization of forest biomass for energy production; to develop methods and techniques for biomass inventory, assess environmental impacts of biomass harvesting and develop methods of reforesting areas harvested for biomass production.

**Achievements:** Funding for this project is through the ENFOR program with basic funds provided by the Department of Energy, Mines and Resources. Trials and investigations are contracted out to consultants and to operating companies. Contractors for 1981-82 are Northland Associates Ltd., Abitibi-Price Inc. and Bowater Newfoundland Limited. The Newfoundland Department of Forest Resources and Lands has taken an active role in providing technical assistance in studies involved with harvesting and inventory matters. As part of the study to develop a biomass inventory, tree-weight data from approximately 600 black spruce, white spruce, balsam fir, larch and white birch were collected from eastern Newfoundland for the production of oven-dry biomass equations; such equations for commercial tree species of central Newfoundland were completed and the results published. A contract was undertaken with Bowater Newfoundland Limited to conduct a two-phase biomass harvesting and burning trial during 1981 and 1982. Phase one of the trial was carried out from July to December 1981. Residues consisting mainly of white birch were removed from cutovers, chipped at roadside and transported to the mill for fuel. One burning test

was undertaken. Equipment for phase two "Integrated pulpwood/biomass harvesting" has been acquired. A cooperative study with Abitibi-Price Inc. included the reforestation of areas from which hardwoods had been removed for chipping. Site preparation and planting have progressed and the plantation was measured for mortality and height growth after one year. Approximately 145 species and varieties of **Salix** from Europe and North America are being propagated to produce cuttings for outplanting on various sites across Newfoundland to test their suitability for energy plantation stock. Four contractors' reports were prepared on various phases of the ENFOR project, two presentations were made at a bioenergy R & D seminar at Winnipeg, and a special CBC news documentary discussed the use of willows for future bioenergy. A formal evaluation of the ENFOR project was undertaken at Gander in November which included representatives from the principal agencies concerned with the project.

### List of Studies

1. Development of biomass equations for major tree and shrub species.
2. Whole tree chipping for hog fuel.
3. Integrated logging for production of pulpwood and hog fuel.
4. Forest biomass inventory conversion.
5. Reforestation after whole tree chipping for hog fuel.
6. **Salix** (willow) for biomass fuel and energy conservation.
7. Harvesting forest biomass as an alternate fuel.

## PROJECT 421
## Environmental Effects of Forestry Practices

**Objectives:** To assess and evaluate the physical impact of forest management practices on forest and wildland ecosystems; to test ameliorative measures, and to develop guidelines and prescriptions for minimizing disturbances and for maintaining or improving forest productivity in areas disturbed by forestry practices.

**Achievements:** Preliminary investigations to determine the feasibility of conducting terrain analyses for logging and silvicultural systems were carried out. A preliminary terrain classification is in the draft stage and initial field studies to determine machine-terrain interactions are partially completed. Technical and professional assistance was provided to the Department of Forest Resources and Lands both in planning silvicultural equipment evaluations and in carrying out environmental impact studies following whole-tree logging for fuel chip production. Aerial and ground surveys of cutovers to determine the range of environmental and silvicultural problems associated with logging were completed and a preliminary annotated bibliography on the environmental effects of timber harvesting was prepared. A study to determine acceptable widths of filter strips to protect and maintain natural habitats along resource roads was completed; a handbook of filter strip tables was developed and is under editorial review. Seminars on site protection and erosion were presented to Bowater Newfoundland Limited and the Provincial Agriculture Land Use Planning Unit. Through the Watershed Committee a schedule for

developing a municipal watershed management plan was prepared for the City of St. John's; the committee also drafted terms of reference for preparation of such a plan. Protected watersheds on the Avalon Peninsula were catalogued and mapped. A report "Fuelwood potential of logging residues in central Newfoundland" was prepared. Data analyses of residue volumes following sawmilling operations are in progress. A report on the Environmental Impact of Forestry Practices was prepared for the Royal Commission on Forest Protection and Management. A formal evaluation of the project was conducted in February in which a variety of agencies having forestry and environmental concerns participated.

### List of Studies

1. Environmental assessment of logging practices.
2. Environmental guidelines for resource development in municipal watersheds.
3. Environmental assessment of forest resource roads and highways.
4. Operational terrain classificaiton.

## PROJECT 431
## Forest and Plant Ecology

**Objectives:** To determine the ecological relationships between major vegetation types of Newfoundland and Labrador and their natural environment, to develop an increased understanding of the response of major vegetation types to such activities as drainage, fire, logging, etc.; to increase knowledge of the autecology of tree and shrub species having special significance in Newfoundland and Labrador; to acquire baseline data on land resources of the Province; to apply the knowledge generated from such studies to forest and other land management problems and to improved environmental assessments of various undertakings.

**Achievements:** Chapters on the soils, peatlands and heathlands of Newfoundland were submitted to a book that is being published in cooperation with the Biology Department of Memorial University of Newfoundland "Biogeography and Ecology of the Island of Newfoundland". These chapters provide a current comprehensive review of studies undertaken by members of the forest and plant ecology project. A final draft of a thesis on the successional status of dwarf shrub heaths was completed and submitted for final review. New studies on the impact of the spruce budworm on forest succession were initiated and preliminary results reported in a file report. Liaison is being maintained with the Newfoundland Goverhment's wildlands advisory Council for the future establishment of ecological reserves under the new Wilderness and Ecological Reserves Legislation. Also, cooperative studies are being initiated with the Newfoundland Wildlife Service on mapping and productivity analysis of caribou range. A journal article on the distribution, morphology and vegetation of Newfoundland peatlands for fuel was presented to the Institute of Gas Technology. Further progress was made on the peatland classification of Labrador. A paper on the ecology of red pine was presented to the annual meeting of the Canadian Botanical Association (CBA) and a PhD thesis on the same subject is being prepared. A report on the distribution and

potential of red pine in Newfoundland was prepared for the Royal Commission on Forest Protection and Management. A checklist of the alpine flora of Western Brook Pond and Deer Pond areas of Gros Morne National Park was accepted for publication in Rhodora. The 1980 workshop paper on palsa bogs, sand dunes and salt marshes of southeastern Labrador was published. A classification of gravel pits along the Trans Canada Highway in Newfoundland was presented at the national symposium of the Canadian Botanical Association. A paper on the ecology of serpentinized areas of western Newfoundland was presented to the XIII International Botanical Congress in Sydney, Australia. A special environmental screening and coordinating committee was formed to screen forestry activities proposed under the Federal-Provincial forestry agreements. In peatland activities, NeFRC staff held offices of chairman of the Canadian National Committee of the International Peat Society and of Commission I of the Society. Assistance was given the Ontario Government in organizing a major symposium at Thunder Bay. NeFRC is represented on the newly formed National Research Council Peat Forum and was the developer of a national R & D program on peatland inventory methodology. Within the Ecoregions Working Group a preliminary vegetation legend for the national map was prepared. Also the final format of the national map for the Atlas of Canada was decided.

### List of Studies

1. Multiple use potentials of wetlands.
2. Ecological investigations of heathlands.
3. Forest classificaiton.
4. Autecological study of larch.
5. Autecological study of red pine in Newfoundland.
6. Ecology of Newfoundland soils.
7. Wetlands (CCELC) national and international activities.
8. Services to FEARO and RSCC.
9. Eco-regions of Canada (CCELC).

## PROJECT 610

## Long Range Transport of Air Pollutants (LRTAP)

**Objectives:** To determine the relative sensitivity of forest species to acid precipitation; to determine the long-term effects of simulated acid rain on selected forest species and on nutrient depletion in soils and the degree of irreversibility of its effects.

**Achievements:** Construction of a greenhouse equipped with an acid rain dispensing system for LRTAP studies was started in 1981 and will be completed by fall of 1982. Some 150 intact soil profiles (10 cm diameter X 60 cm depth) were sampled from a forest site in western Newfoundland. These soil profiles will be used for greenhouse studies on the effect of simulated rainfall on nutrient depletion in soil and its effect on plant growth. Foliage samples were collected and frozen to study the daily, seasonal, and

specific variations in buffering capacity of foliage of selected tree species. Experiments on the effect of acid rain on pollen and seeds were initiated. It was found that a pH of rain below 4.6 inhibits the germination of white spruce pollen significantly. Also temperatures during incubation are critical and may alter the effects of acid rain. Effects on pollen of other tree species will be studied in future to establish a spectrum pH of precipitation which inhibits normal germination of pollen and therefore seed production. A method of sulphur analysis using ion chromatography was developed and refined. A journal paper on buffering capacity of foliar extracts was submitted for publication. A short paper was published in "Woody Points" and a paper was contributed to a LRTAP workshop held in St. John's, Newfoundland. This project was given a formal evaluation by representatives from a number of environmental and other concerned agencies in February 1982.

### List of Studies

1. Effects of acid rain on vegetation and soils in Newfoundland.

## PROJECT 620
## Toxic Chemicals

**Objectives:** To assess the effects of industrial pollutants on vegetation and soils; to develop ameliorative measures and guidelines to minimize the effects of air pollution; to evaluate the adequacy of existing air quality standards for the protection of terrestrial ecosystems in Newfoundland; to provide an advisory service to provincial and industry officials on monitoring short and long term effects of pesticide and herbicide sprays on vegetation and soils.

**Achievements:** Monitoring of air, vegetation and soil was continued for fluoride damage in the Long Harbour area. The damage during 1981 was more severe than in 1980. This was substantiated by higher deposition of gaseous fluorides on fluoridation plates and higher accumulation of fluoride in foliage in 1981 than in 1980. The F-accumulation was greater than 35 ppm (provincial standard) in foliage up to a distance of at least 8 km northeast of the source. A monitoring program was prepared for the Come by Chance refinery area. Vegetation and soil were surveyed and permanent sampling plots were set up at the request of the Provincial Government and Petro Canada. Newfoundland Hydro was advised on the impact of $SO_2$ near their oil-fired generator. Chemical analysis of asbestos dust and vegetation from Baie Verte was completed. Two papers were completed — one on buffering capacity of foliage and the other on the results of five years of air monitoring in the Long Harbour area. Results of the fluoride study were presented at meetings with EPS, Nfld. DOE, ERCO and Boyce Thompson Institute. This project was also evaluated in February in conjunction with the LRTAP evaluation.

### List of Studies

1. Effects of fluoride emissions on vegetation and soils.
2. Effect of non-gaseous air pollutants on vegetation and soils.
3. Advisory services to environmental agencies.

# Forest Protection Research

## PROJECT 271
## Insects and Diseases

**Objectives:** To develop methods for sampling populations of forest pest species, their parasites and predators; to investigate the biology of pest species, their impact on forest stands, and to develop methods to minimize losses from forest pests.

**Achievements:** Isolation of fungi from the stored seeds of various conifers was continued and the isolates now total 32 species. In the field, fungi occurred in seed from opened or partially opened cones but were absent in unopened cones. The inland cone rust, a conspicuous disease in black spruce cones in young stands, was found at eight locations in eastern and central Newfoundland and at four locations in eastern Labrador. From 12-85% of trees were infected and 4-27% of cones on infected trees were affected. Surveys have determined pests of concern in cones and seeds of several tree species. On black and/or white spruce the spruce coneworm, the spruce maggot,, the spruce cone beetle and cone midges are important. On balsam fir a cone maggot, the spruce coneworm, cone midges and a seed chalcid are important. No serious pests of white and red pines have been observed to date. The spruce (deathwatch) cone beetle is expected to continually cause seed losses under normal forest conditions but recent developments in the Provincial seed procurement program now permit cones to be harvested and seed extracted before much damage occurs.

Sampling for the balsam woolly aphid indicated the developing outbreak in western Newfoundland has persisted. An annotated bibliography on the balsam woolly aphid was published.

More of the European larval parasites of the European pine sawfly were released in 1981. Nearly 2000 larvae were reared to the cocoon stage to check on the establishment of cocoon parasites. In 1981 the European parasite of the mountain-ash sawfly was collected in Quebec and released in St. John's. Nearly 2500 larvae of the larch sawfly collected in 1981 were reared to the pupa stage to determine parasitism. No parasites of the birch leafminer were collected in either 1980 or 1981 because the host population level was extremely low. In 1981 an introduced dipterous parasite of the hemlock looper was recovered from two of seven sample locations. Sampling of shrew populations has continued.

In 1981 hemlock looper populations on the Northern Peninsula collapsed but larvae were collected in other areas to establish laboratory colonies at NeFRC and at the Forest Pest Management Institute to provide moths for pheromone extraction. Research has determined that a sex pheromone is present in the hydro-carbon fraction of extracts of the female pheromone glands. Several thousands of pupae were reared in support of this study.

Greenhouse inoculation experiments are being maintained to record **Armillaria mellea** development and host reaction. Additional **A. mellea** samples from fluoride damaged stands were chemically analyzed. A preliminary investigation of this root rot was conducted in balsam fir stands damaged by the spruce budworm. Isolates of **A. mellea** were obtained from 22 tree species. Damage is more severe in plantations than in natural stands.

Annual mortality data from insect damage stands were summarized and stored on computer tape as a reference for studying progression of mortality and losses. Investigations of deterioration of wood stored in stacked woodpiles indicated considerably less deterioration in 4-foot pulpwood piles than in 8-foot or tree length piles. Measurement of decay, form and wood quality of living trees was continued and data are available from 300 plots throughout the Island. Analysis of this data is being completed and a computer program developed to summarize volume equations and tables. Sawlog volume tables developed in cooperation with the Provincial Department of Forest Resources and Lands are ready for publication.

The role of woodborers and other secondary insect species in tree deterioration is being assessed on felled trees at two locations. Extremely low Siricid populations noted since 1979 may alter the normal sequence of decay of budworm killed trees.

Information output has included participation in a number of meetings of forestry officials in the region for communication of results of studies. Special meetings have been held for discussions of Armillaria, cone and seed insects, their impact and control. Researchers gathered at a national meeting to discuss CFS cone and seed studies.

A total of seven journal equivalent papers, four information reports and thirteen unpublished reports were produced and in February the project was given formal evaluation which included participants from several agencies external to NeFRC.

## List of Studies

1. Cone and seed fungi of softwoods.
2. Insect damage in cones and seeds of softwoods.
3. Development of damage from balsam woolly aphid in balsam fir stands.
4. Populations of introduced biological control agents.
5. Sex pheromone(s) of the eastern hemlock looper.
6. Armillaria root rot.
7. Deterioration of trees damaged by insects.
8. Decay, microflora and wood quality of living trees.
9. Role of woodborers in tree deterioration.

# PROJECT 281
# Spruce Budworm

**Objectives:** To study the population dynamics of the spruce budworm in Newfoundland, assess its impact on major age classes of forest, and develop methods to minimize forest losses.

**Achievements:** Population levels of the spruce budworm were measured for the seventh complete generation in 1981. Larval numbers were high in early June as expected in most sample localities, but decreased drastically between June 28 and July 10. The data for all seven generations are now being placed on computer and being analyzed. Work continued on relating degree day requirements for budworm development and a computer program for calculating cumulative degree-days was prepared for final analysis of the data.

The incidence of biological control factors (predators, parasites, and diseases) in 1981 budworm populations was determined. About 8% of budworm larvae were parasitized, about 8% diseased, and 30-40% died of unknown causes. Generally, larvae collected in late June had the highest percent of death by unknown causes (up to 90%). Fungal diseases caused about 1% mortality and microsporidia were found in about 7% of the larvae. Field trials in 1981 to establish epizootics of **Zoophthora radicans** and **Entomophthora egressa** failed, though **E. egressa** was recovered in some larvae following release. Currently the Provincial Department of Forest Resources and Lands has a contract with the Biology Department, Memorial University, to conduct research on mass production of spores of **Entomophthora** sp. NeFRC provides scientific cooperation in this study. A nematode **Heterorhabditis heliothidis**, appears promising as a biological control agent and a contract research project was initiated late in the year between NeFRC and with Memorial University Biology Department to study the use of nematodes in budworm control. In cooperation with the Provincial Department this contract was later extended to include control of balsam woolly aphid through use of nematodes.

Permanent sample plots in fir regeneration were monitored in 1981. Trees that survived severe defoliation in the mid-1970s have now almost completely recovered. Only trees currently under severe attack were classed as moribund. Annual monitoring of 77 permanent plots in semi-mature stands continued. Severity of current defoliation dropped to 16% in 1981 compared to 56% in 1980. Cumulative tree mortality increased from 18% in 1980 to 24% in 1981, and for spruce from 6% to 17%. In general, tree vigor increased slightly in 1981. Several representative damaged stands in western Newfoundland were surveyed, and some data collected to assess the impact of the spruce budworm on forest succession. The project was evaluated in February by representatives from several agencies.

### List of Studies

1. Population studies of the spruce budworm.
2. Influence of weather on populations of the spruce budworm.
3. Role of predators, parasites and diseases on the population dynamics of the spruce budworm.
4. Impact of spruce budworm on immature stands.
5. Impact of spruce budworm on semi-mature stands.
6. Impact of spruce budworm on cones and seeds.
7. Impact of spruce budworm on wildlife forage.
8. Effects of insecticidal sprays on biological control agents.

## PROJECT 291
## Forest Insect and Disease Survey

**Objectives:** To conduct systematic surveys of forest pest conditions, determine the extent of infestation, assess the impact and recommend control measures.

**Achievements:** The annual general detection, monitoring, appraisal and forecast of forest insects and diseases were continued, the data analyzed and interpreted, and presented to forest resource managers in the form of publications, reports, "Woody Points" articles, and at special meetings called to discuss specific problems. Data from the above surveys provide resource managers with the information necessary to evaluate forest insect and disease problems and to plan and conduct the control action and salvage operations necessary to minimize wood losses. Spruce budworm damage appraisals showed that such surveys have detected a number of new forest pests in recent years including European pine sawfly, ugly nest caterpillar, Scleroderris canker, and a number of other tree diseases. The extent of defoliation in the productive forests of the Island decreased from 926 000 hectares in 1980 to 380 000 hectares in 1981. The spruce budworm eggmass survey was completed in September in 800 locations throughout the Province to forecast areas of infestation in 1982. Spruce budworm hazard ratings were completed and show a moderate to high hazard rating on about 70 000 ha in 1982. Estimates of forest depletion from insects and diseases during the last five years were provided for inclusion in the publication of the National Forest Resource Data Program. The outbreaks of the larch and spruce beetles increased and a special survey was made in October to assess the area and volume of damage caused by those pests. A survey of balsam woolly aphid was conducted and infested areas were found to have increased significantly in western Newfoundland over those reported in 1981. A severe outbreak of Scleroderris canker (European race) was discovered in a 4-acre red pine plantation near Torbay and recommendations were made to Provincial authorities to cut and burn the trees. Pheromone traps were operated in cooperation with Agriculture Canada in an attempt to detect the possible accidental introduction of gypsy moth, a destructive forest insect. No moths were caught in the traps in 1981 although one male moth was captured in 1980. Pest information was

provided to forest and environmental agencies and to the general public through publications, reports, semi-technical articles, talks, workshops and displays. Lectures and demonstrations were also given to students of Memorial University and the College of Trades and Technology. A formal evaluation of the project which included over 50 participants from various agencies was held in February.

### List of Studies

1. Detection and forecasting forest pest conditions.
2. Taxonomy and biology of forest pests.

# Forest Economics

## PROJECT 121

## Economic Guidelines for Resource Allocation

**Objectives:** To undertake economic studies on particular resource management problems and opportunities; to provide advice on forest economics to the Canadian Forestry Service on priorities in research and development activities and to client agencies on development of sound forest resource programs.

**Achievements:** The principal accomplishments were the advisory services provided to federal and provincial agencies concerned with forestry development. The project leader was a member of the management committee of the Forest Economic Stimulation Program — a special job creation Federal-Provincial agreement for salvage harvesting and forest improvement programs. A special committee which included NeFRC representation completed a final evaluation report of the forest Federal-Provincial forestry agreement and developed a work schedule for evaluation of the second agreement. An interim evaluation report was prepared for the economic stimulation project. Economic analyses were undertaken of forest losses to spruce budworm and a report prepared for the Royal Commission on Forest Protection and Management. Another economic analysis was conducted of the sawmill and planing mill industry of the Bonavista Peninsula and a report was published. A special report dealing with an economic analysis of silvicultural investments was provided to the Royal Commission on Forest Protection and Management.

### List of Studies

1. Advisory services to CFS and other agencies.
2. Forest economic stimulation program.
3. DREE forestry agreement evaluations.
4. Forestry subsidiary agreement management committee.
5. Economics of forest improvement in Newfoundland.
6. Economic impact of forest insects.
7. Economic impact of forest industries.

# PROJECT 142

## Forest Resource Data

**Objectives:** To establish a data bank of forestry and forest industry statistics for Newfoundland and provide regional input into the Canadian Forest Resource Data Program.

**Achievements:** Work is continuing on the compilation of a statistical data base drawing on several information sources. Statistics have a time series base of twenty years and are being developed for computer storage and retrieval. Assistance was provided to the Forest Statistics and Systems Branch in the collection of provincial statistics for the National Inventory Report due in 1982. A general interest publication of Newfoundland forestry statistics was published.

### List of Studies

1. Newfoundland forestry statistics.
2. Canadian forest resource data program.

# Information Services

**Objectives:** To develop a public awareness of activities of the Canadian Forestry Service and to encourage appreciation of the economic, recreational and aesthetic values of the forest resource and of the need to protect and enhance it.

**Achievements:** The information program has been a continuing one since 1967. In 1981 publication of the Research Centre's newsletter "Woody Points" was continued and a total of six issues containing forty-seven articles and reports on research and related achievements were published. The Program Review 1979-81 was compiled and published. The Centre's public awareness program was expanded in cooperation with the Provincial Department of Education. This expanded awareness program resulted in approximately 500 individual requests for resource material. Information services arranged for a number of lectures and talks to be given at various secondary schools, technical colleges, civic and youth organizations. Articles were prepared for news media to highlight activities during National Forestry Week and National Environment Week. The Centre's mobile display was improved and the number of exhibits increased. Existing awareness publications produced by the Centre were reviewed and a joint project to improve these publications was initiated with the Provincial Department of Lands and Forests. Advice and guidance to management and staff was provided during the program review period November 1981 to March 1982 to ensure sufficient media exposure and adequate logistics. Liaison activities were increased with the Department of Forest Resources and Lands, the Newfoundland Department of Education, industry, the Newfoundland Forest Protection Association and other cooperators with the Research Centre who provide information on forestry in the Province. The Research Centre's information program also provided assistance to other services of Environment Canada including Inland Waters, Canadian Wildlife Service and Atmospheric Environment Services.

# Common Technical Support Services

**Objectives:** To provide an efficient and high quality technical support service to meet the needs of the NeFRC research and development program.

**Achievements:** The technical common support services include the herbarium and insect reference collection facilities, computer services and a soil chemistry and physical analysis laboratory. Activities of each support service follow:

(1) **Mycological Herbarium** — Collections were continued for the mycological herbarium which currently contains about 2500 specimens, and three forest diseases were recorded for the first time in Newfoundland. (2) **Insect Reference Collection** — This collection was started in 1951 and now contains nearly 1500 specimens and about 200,000 alcohol-preserved immature forms. A biological survey was continued and over 300 new species were added to the collection. A number of specimens collected have been retained by the Biosystematic Research Institute, Ottawa, for addition to the Canadian National Collection. (3) **Plant Herbarium** — The herbarium continued to provide a service to scientists in forest ecology studies and related biosystematics and vegetation management research. Requests were received nationally and internationally and the herbarium curator represented NeFRC on a special committee to administer the Canada Seeds Act. This herbarium was established in 1956 and now contains a specialized collection of plants, e.g. Cyperaceae, peatland flora, native and exotic dendroflora, etc., and the collection is registered in Index Herbariorum. (4) **Seed and Planting Stock Service** — Seed collection and seedling production were continued in line with the objective of the Service. Over 120,000 seedlings were grown and a major effort was made in production of willow cuttings for an ENFOR project. (5) **Chemical and Physical Analysis Laboratory** — Soil and foliage analyses were continued for established research projects and some aspects of the project were expanded to accommodate the LRTAP program. New analytical methods were developed and evaluated. Since the laboratory was established in 1969, analyses of plants and soils were conducted on about 20,000 samples. (6) **Computer Services** — Installation of a new computer system was initiated — a PDP 11/44 unit with 120,000 words of memory. At present there are three terminals (two VT131's and an LA34) linked into it. The system consol (an LA 120) may also be used as a terminal. Equipment was ordered which will allow the HP-85 to be used as a terminal as well. A large plotter, a magnetic tape storage system, and an additional 512,000 words of memory were ordered.

# Administration

**Objectives:** To provide a system of financial control and accountability and other administrative support services, e.g. material management, records management, library, secretarial and stenographic services, vehicle fleet management and personnel liaison services; to administer the provision of accommodation, meals and working requirements at two field stations.

**Achievements:** Financial management and accountability was provided in a highly satisfactory manner as were all other administrative support services identified. Vehicle fleet management was maintained and six vehicles were replaced. The Department of National Health and Welfare conducted examinations on field station accommodatins and recommended minor improvements. Similar examinations were conducted by the Department of Labour officials on working conditions in the Research Centre building at St. John's and improvements were recommended in certain laboratory facilities. Interior painting of buildings at field stations was undertaken and is scheduled for completion prior to next field season. Repairs and/or replacement of furniture and other items were carried out. Minor electrical and plumbing repairs were performed in order to upgrade these systems.

A personnel service of one person year was established. The duties of the position have been defined as primarily pay and benefits but the function has been greatly expanded to include an overall personnel liaison service with the Personnel Office in Halifax. One person year was provided to serve the AFMAS accounting system. The position was filled and training in procedures is progressing.

Work is in progress on new greenhouse facilities for NeFRC. Additional office and laboratory space was provided in another Public Works building adjacent to the one now occupied and plans were made for extensive renovations of the building. Several employees were given first aid training and a defensive driver's course. On-the-job injury and vehicle accidents were minimal.

A library service was continued. Acquisitions during the year included about 100 reference books, 400 serials and about 1000 inter-library loans. About 800 reference books and monographs were checked on ELIAS (a national system for cataloguing) or were placed in the currently used Oxford system and cards made.

## APPENDIX A

### NEWFOUNDLAND FOREST RESEARCH CENTRE
### EXPENDITURES ($000's) 1981-82

| Program area | P/Y | Salaries | O & M | Capital | Total |
|---|---|---|---|---|---|
| Forest Resources | 24.0 | 639.4 | 130.1 | 70.3 | 839.8 |
| Forest Environment | 4.0 | 138.1 | 42.5 | 15.5 | 196.1 |
| ENFOR | 2.0 | 69.1 | 298.1 | - | 367.2 |
| Forest Protection | 26.0 | 762.4 | 165.0 | 76.0 | 1,003.4 |
| Forest Economics | 2.0 | 74.7 | 16.8 | 7.0 | 98.5 |
| Information | 1.0 | 29.9 | 13.0 | 1.0 | 43.9 |
| Management and Administration | 15.0 | 343.8 | 120.0 | 43.8 | 507.6 |
| TOTAL | 74.0* | 2,057.4 | 785.5 | 213.6 | 3,056.5 |

*Includes 26 COSEP students seasonally employed.

## APPENDIX B

### 1981-82
### CONTRACTS BY NeFRC

| Name of Contract | Company | Amount |
|---|---|---|
| 1. Comparative study in harvesting forest biomass as an alternate fuel. | Bowater Newfoundland Limited, Corner Brook | 150,000 |
| 2. Reforestation of areas harvested for biomass. | Price (Nfld.) Pulp and Paper Ltd., Grand Falls | 6,070 |
| 3. Tree weight equations for Newfoundland. | Northland Associates Ltd., St. John's | 102,488 |
| 4. Isolation, identification and bioassay of the sex pheromone of hemlock looper. | Research and Productivity Council, St. John's | 8,000 |
| 5. Script writing, consultation and narration for two slide shows. | David Quinton, St. John's | 1,200 |
| 6. Forest regeneration surveys using large scale aerial photography. | Hunter & Associates, St. John's, Nfld. | 8,140 |

Note: Contracts 1 to 3 are part of the Energy from Forest Biomass program.

## APPENDIX C

### STAFF LIST AND ORGANIZATION 1981-82

Regional Director .... Dr. W.J. Carroll
Secretary .... E.E. Manuel

### FOREST RESOURCES AND ENVIRONMENTAL RESEARCH

Program Manager .... Dr. F.C. Pollett

| | |
|---|---|
| Chemical and Physical Analysis Laboratory | J.G. Zakrevsky, E.M. Pike, T. Slaney |
| Forest Ecology - Impact Assessment | A.B. Case, J.G. Donnelly |
| Forest Ecology - Succession | W.J. Meades, G.J. Mills |
| Wetland Ecology | E.D. Wells, S.M. Morgan |
| Soils - Autecology | B.A. Roberts, B.A. Janes |
| Silviculture - Forest Regeneration/ Hardwood Control | J. Richardson, V. Chaffey |
| Silviculture - Mensuration, Biomass, Fertilization | R.S. van Nostrand |
| Silviculture - Natural Regeneration | J.M. Butler |
| Tree Biology - Forest Genetics | Dr. J.P. Hall, W.J. Curran |
| Tree Biology - Forest Genetics | Dr. M.A.K. Khalil, L. May |
| Ecophysiology/Stand Modelling | M.B. Lavigne, P.T. Tricco |
| Pollution Ecology - Air Pollutants and Toxic Chemicals | Dr. S.S. Sidhu, C.T. French |
| Herbarium Curator | A.W. Robertson |
| Nursery Services | C.H. Evans |

### FOREST PROTECTION RESEARCH

Program Manager .... Dr. J. Hudak

| | |
|---|---|
| Insect Populations | E. Dobesberger, J. Carter |
| Entomology - Damage and Impact | H.O. Schooley, L. Oldford |
| Entomology - Damage and Impact | Dr. A.G. Raske, J.D. Rowe |
| Entomology - Biological Control | Dr. K.P. Lim, D.S. Durling |
| Mycology, Pathology, Insect & Disease Survey | G.R. Warren, J.P. Meades, A.L. Fudge, J.W. Marshall |
| Fire Control | Vacant |
| Computer & Statistical Analysis | R.G. Hunter |
| Forest Insect & Disease Survey | L.J. Clarke, K.E. Pardy, E.D. Banfield, D.S. O'Brien, W.J. Sutton, D.M. Stone |

### FOREST ECONOMICS AND RELATED SERVICES

Senior Economist .... Dr. J.A. Munro
Economist .... G.R. Milne

### INFORMATION SERVICES

Information Officer .... D.R. Rex

### ADMINISTRATION

| | |
|---|---|
| Chief, Finance & Administration | R.F. Best |
| Finance | W.F. Walsh, E.C. Higdon, M.A. Martin |
| Purchasing | F.L. Bannister |
| Personnel | J.A. Landrigan |
| Library | C.E. Philpott |
| Central Registry | L.J. Fennelly |
| Office Services | D.J. Didham, M.F. Gillingham B.M. Bartlett |
| Field Station Facilities | W.V. Bonnell |

## APPENDIX D

## PUBLICATIONS

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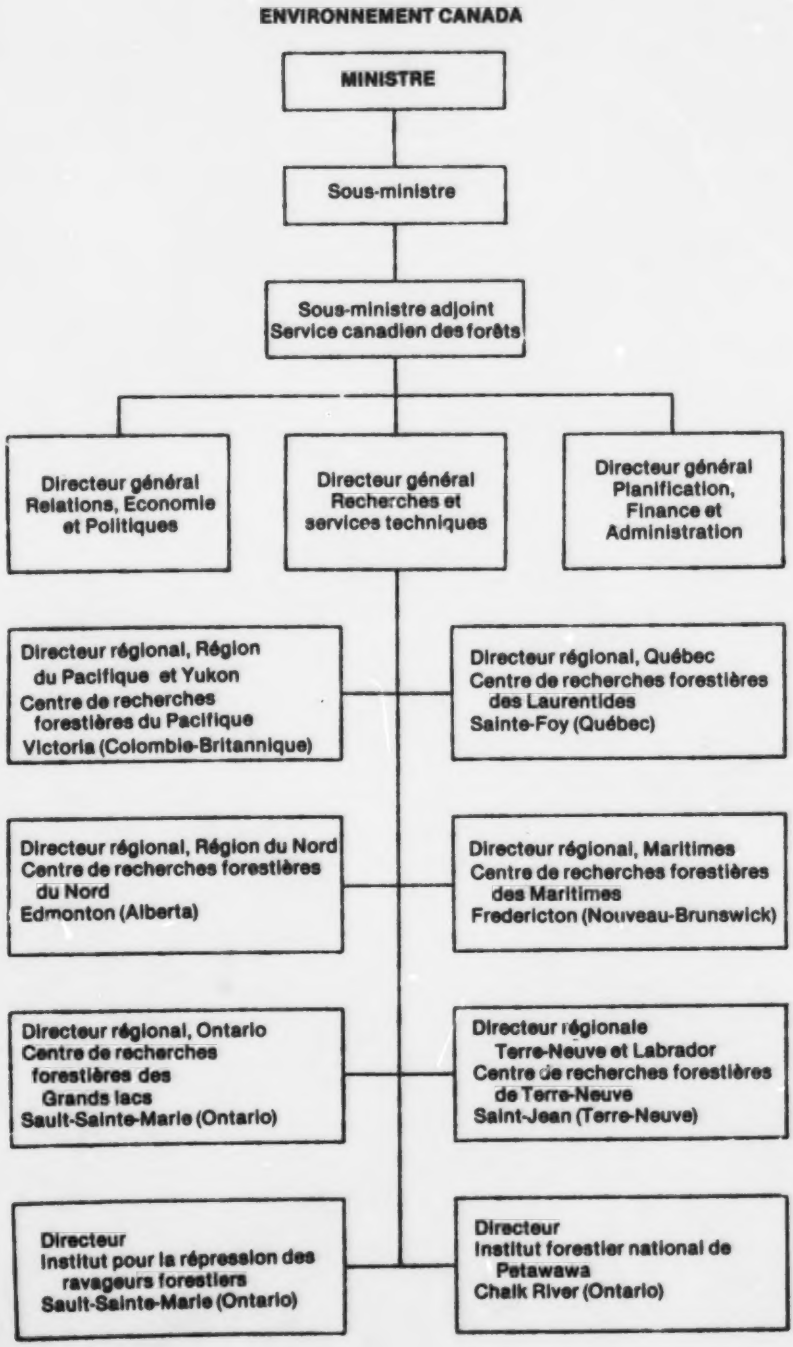
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